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BURYING FOREST RESIDUE--AN ALTERNATIVE TREATMENT

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ABSTRACT

Burying forest residue in a mixed conifer stand which had been shelterwood cut was economical and effective. The fire hazard was reduced to an acceptable level and obstacles to future harvest operations were eliminated. This treatment also provided easy access for dispersed recreation and wildlife and eliminated a breeding ground for insects. The operation cost was about $83 per acre (1975 price). Burying is a residue treatment which can be used for shelterwood cut areas usually on a one-time basis only. Soils should be deep enough for pits 5 feet (1.5 m) in depth.

KEYWORDS: Slash disposal, forest residues.

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Even with today's improved utilization possibilities, timber harvesting practices continue to produce excessive accumulations of residue. Shelterwood cutting techniques in mixed conifer stands east of the Cascade Range in the Pacific Northwest are no exception. Residue accumulations may restrict dispersed recreational opportunities, act as a breeding ground for insects, impede movement of wildlife, and generally limit efficient forest management. These residues must be treated in some manner to eliminate obstacles to future harvest and to reduce the fire hazard.

If the benefits of shelterwood cutting are to be realized, harvested stands must be protected. One alternative may be to bury the residue within the harvested area. This paper reports the results of a study done to determine cost, time, and effect of burying forest residue.

Results of a feasibility study conducted in California (Schimke and Dougherty 1966) indicate that burying residue shows promise as a treatment for areas that are not too steep or rocky. Slash burying has also been used successfully as a disposal method on the Butte Falls Ranger District of the Rogue River National Forest in Oregon for many years. Roadside pits installed in 1961 showed no evidence of settling by 1975. A good grass cover has been reestablished, and mixed conifer reproduction, up to 4 feet (1.22 m) high, is growing on the pit sites.[2/]

STUDY PROCEDURE

The study was conducted on a 63-acre (25.5-hectare) area on the Sisters Ranger District of the Deschutes National Forest in Oregon which contained fairly homogeneous residue. The prevalent species was white fir (*Abies concolor* (Gord. & Glend.) Lindl.) with lesser amounts of ponderosa pine (*Pinus ponderosa* Laws.), larch (*Larix occidentalis* Nutt.), Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), and western redcedar (*Thuja plicata* Donn) on deep, sandy loam soil. The slope ranged from 0 to about 10 percent.

A line transect method of sampling was used to determine the amount of residue (Van Wagner 1968). A 3,000-foot (914.4-m) continuous transect line was used with a new random azimuth chosen for each 100-foot (30.48-m) segment.

Residue volume was determined by using the equation:

$$V = \frac{373.3092\ \Sigma d^2}{L}$$

where:

V = volume in cubic feet per acre
d = diameter of pieces of residues in inches
L = length of total transect line in feet

The equation used for finding residue weights was:

$$W = \frac{11.65\ S\ \Sigma d^2}{L}$$

where:

W = weight of residue in tons per acre
S = specific gravity (0.42 was used for this study).

[2/] Rambo, Ira. 1975. Personal conversation. U.S. Dep. Agric., For. Serv., Butte Falls Ranger District, Butte Falls, Oreg.

Pit locations were selected that would permit excavation with little or no bole injury or result in excessive root damage to residual trees. A Caterpillar D7E[3/] tractor was used to dig the pits and a Case 1150 tractor to push the residue into them and to cover each with at least 2 feet (0.6 m) of soil. The time required for each operation and costs were recorded.

Rate of fire spread and resistance to control conditions were determined for the area as a whole before and after treatment. The fuel type identification system of the Pacific Northwest Region of the U.S. Forest Service (U.S. Department of Agriculture, Forest Service 1968) was used to determine the relative degree of fire hazard and its reduction due to burying the residue. In this system, fuels are classified by one of four rate-of-spread and one of four resistance-to-control categories, making 16 possible fuel type combinations. The four categories in both classifications are extreme (E), high (H), moderate (M), and low (L). The hazard rating was based on observations made from several points within the study area.

The general condition of trees which had sustained root or bole damage or both was evaluated immediately after the pits were dug and 3-1/2 years after treatment. They were rated as either in good (green and vigorous looking) or poor (excessive dead needles or appeared to be much less vigorous) condition or as dead. The study area was broadcast seeded with grass.

In 1973, 3 years after treatment, a forest pathologist examined damaged trees adjacent to two selected pits and exhumed residue from those pits to determine if burying residue had caused the appearance of forest disease, especially that of root rot. One pit was on a well-drained site and the other on a poorly drained site. Disks 2 inches (5.08 cm) thick were cut from pieces of residue collected from the pits and from the boles of selected standing live trees. Pieces cut from the disks were incubated in either moist sand to test for *Armillaria mellea* or on wet paper towels to test for the *Oedocephalum* stage of *Fomes annosus*.[4/]

Two healthy trees adjacent to the two pits were pushed over with a tractor to permit examining roots broken at the time of residue burial. Also, the general biological condition of each pit was observed.

RESULTS

There were 3,863 cubic feet per acre (270.3 m^3/ha), or about 51 tons per acre (114.3 metric tons/ha), of down and dead residue in the study area before burying took place. Although the residue ranged from 2 to 32 inches (5.1 to 81.3 cm) in diameter, about 90 percent of the material was 10 inches (25.4 cm) or less. The average was about 5 inches (12.7 cm). The arrangement and quantity were rated as HH fire hazard. Burying reduced the surface residue by 80 to 90 percent, lowering the fire hazard to ML. This rating was considered an acceptable hazard level. Pushing the residue to the pits scarified the ground, resulting in bare soil on practically the whole area (fig. 1).

[3/] Mention of product or trade names does not imply endorsement by the U.S. Department of Agriculture.

[4/] Roth, Lewis F. 1973. Pathological implications of forest residue disposed by burial and by prescribed burning. Unpublished manuscript on file at U.S. Dep. Agric., For. Serv., Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Figure 1.--Three views of a mixed conifer stand which has been shelterwood cut: left, before burying logging residue; right, after burying logging residue.

The D7E tractor required 45 hours to dig 72 pits in the 63 acres (25.5 ha). The pits were 10 feet (3.1 m) wide and 5 feet (1.5 m) deep. The length ranged from 20 to 111 feet (6.1 to 33.8 m) and averaged 62 feet (18.9 m). The average time to dig a pit was 38 minutes. The soil was fairly deep and not rocky so no difficulties were encountered.

Pushing the residue into the pits and covering with at least 2 feet (0.6 m) of soil took the Case 1150 tractor about 124 hours, or 1.7 hours per pit (fig. 2). The operator and helper each worked 153 hours.

Figure 2.--Burying the residue with a tractor.

The D7E tractor and operator were rented for $25 per hour (1970 price). The Case 1150 was owned by the Ranger District and cost $3.50 per hour (1970 fixed and operating costs). Operator and helper wages for the Case 1150 totaled $7.68 per hour. Total cost per acre for digging the pits and burying the residue was $43.40 ($107.24/ha). At 1975 prices, the cost would increase to about $83 per acre ($205.09/ha).

The condition of 36 trees was observed: 24 were rated in good condition 3-1/2 years after sustaining root or bole damage or both, 9 trees were dead with only 2 still standing, 2 had been knocked askew, and 1 had a broken top.

No serious endemic root diseases were found. Only one large stump was infected by *Phellinus (poria) weirii*. There was almost no evidence of root pathogens found from samples incubated in moist sand. Out of 239 chips, 2 produced *Oedocephalum* type of growth that could have been the conidial stage of *Fomes annosus*. These chips were from samples taken from aboveground scars on white firs. Rhizomorphs of the *Armillaria* type were found on one of 72 samples tested for *Armillaria mellea*. The rhizomorphs observed were atypical and could have been produced by a fungus other than *Armillaria* (see footnote 4).

Decay by saprophytes was taking place in both pits. Material 1/2 inch (1.27 cm) or less in diameter was completely decayed and absent in the pits. All buried sapwood was in advanced stage of decay. Heartwood decay was progressing, largely due to heart rot activity in logs culled because of trunk rot. No fruiting bodies, rhizomorphs, or other identifiable structures of root pathogens were found in material from the pits.

Very little vegetation had grown on those pits where topsoil was mixed with subsoil. On a few of the pits, the topsoil was not mixed with the subsoil

when replaced; these areas had grass growing on them. Grass and forbs were growing in adjacent areas.

DISCUSSION AND CONCLUSIONS

Burying residue in the study area was effective in reducing the fire hazard to an acceptable level and eliminating obstacles for future harvest operations. It also provided easy access for dispersed recreation activities and wildlife and eliminated a breeding ground for insects.

This residue treatment was efficient and economical. It required about 19 working days (8-hour) to treat 63 acres (25.5 ha) which had about 51 tons per acre (114.3 metric tons/ha) of residue. The cost was about $83 per acre ($205.09/ha) (1975 price).

Scarring of standing trees occurred. This can provide entry courts for butt rots which are capable of killing injured trees and spreading through the roots to other trees. This is particularly true for the nonresinous species such as white fir which was prevalent in this study area. Douglas-fir and ponderosa pine are less susceptible to entry of fungi following mechanical injury. Also, if care is taken not to scar the standing trees, a general weakening of physiological defenses is unlikely.

Trees in the area appeared healthy with little mortality after 3-1/2 years.

Almost all the area was scarified by the operation; however, erosion did not present any problems because of stable soils and gentle slopes. Vegetation did grow back, mainly grasses and forbs, but was very sparse or nonexistent on the pits. This could present problems on erodible soils. Also, the area covered by pits was not productive except where care was taken to replace topsoil; then grasses did well. This amounted to about 1 acre (0.4 ha), or 1.6 percent of the total area. This concurs with work performed in 1973[5/] when slash from ponderosa pine thinning was buried on the Deschutes National Forest using techniques similar to those in this study. The only difference was that the topsoil was removed from each pit, stockpiled, then replaced when the pits were covered. Grass seed was subsequently drilled on all disturbed areas which resulted in the establishment of a good stand of grass.

Burying is a residue treatment which can be used for some shelterwood cut areas. However, one must keep in mind that in most cases this treatment could be used only once for a particular area, depending on the number of pits needed and space between pits. Another method would have to be used if future treatment is necessary for that area. Also, soils should be deep enough for pits 5 feet (1.5 m) in depth.

[5/] Foster, William. 1974. Personal conversation. U.S. Dep. Agric., For. Serv., Sisters Ranger District, Sisters, Oreg.

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